Mobile Network Base Station Design Guide

User Manual

Prepared for the Mobile Carriers Forum and the Design and Innovation Programme Taskforce

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1.0 INTRODUCTION

The purpose of this User Manual is to explain how to use the Mobile Network Base Station Design Guide (the Design Guide) which was prepared as a result of the Mobile Carriers Forum (MCF) Design and Innovation Programme project.

1.1 Background to the preparation of the Design Guide

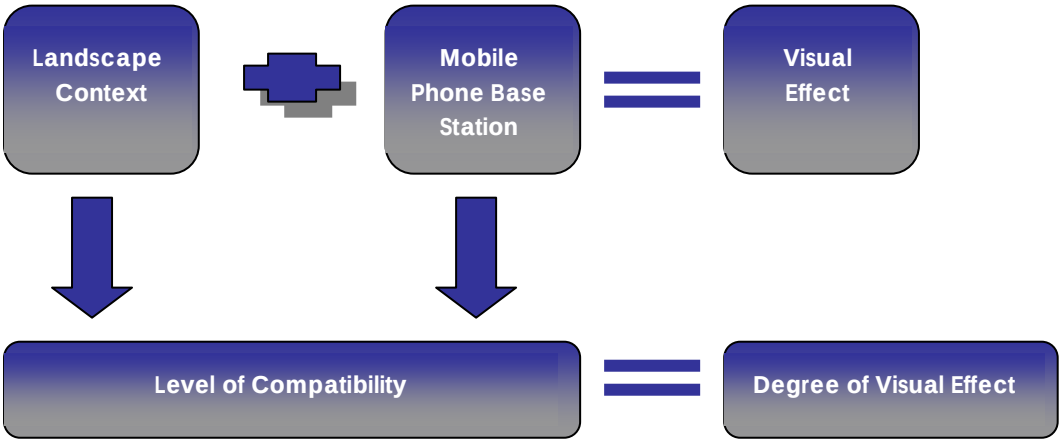
In early 2007, the MCF initiated the MCF Design and Innovation Programme project. The aim of the project was to identify techniques and guidelines which can be applied and supplement everyday mobile phone base station site design processes and assist telecommunications Carriers and their consultants to determine "what to do where" when deploying mobile phone infrastructure in order to achieve better visual outcomes.

One of the key outcomes of the project was the development of the Design Guide, which can assist Carriers and their consultants during the site acquisition process to assess the existing landscape context and develop a mobile phone base station design that is responsive to this context.

The Design Guide is underpinned by the understanding that one of the keys to better addressing the visual effect of mobile phone base stations involves:

- Undertaking a detailed assessment of the landscape in which the mobile phone base station is to be located; and
- Designing the facility to respond appropriately to this landscape setting.

In this way, a mobile phone base station can be designed that is compatible with the landscape context. The higher the level of compatibility of the mobile phone base station design with the landscape, the less significant or intrusive the visual effect. Conversely, the less compatible the mobile phone base station is with the surrounding landscape, the greater its visual effect.



Understanding Visual Effect

1.2 Overview of the Design Guide

The Design Guide provides a structured process which:

- Assesses the existing landscape context of the proposed mobile phone base station site and determines the sensitivity of the visual environment;
- Identifies mobile phone base station design considerations appropriate to the landscape context;
- Provides recommendations to reduce the visual effect of mobile phone base stations through design development; and
- Provides a framework that allows a range of objectives to be balanced against visual outcomes.

The Design Guide can be used to demonstrate to local government, property owners and the community how the proposed mobile phone base station affects the visual amenity of the location and how design strategies can be used to enhance design compatibility and in turn, ameliorate the visual effect.

The Design Guide is an interactive tool and can be accessed via the following website link http://www.mcf.amta.org.au/.

2.0 Structure of the Design Guide

The Design Guide generates unique design recommendations or a "design brief" that responds specifically to site context and landscape character. The Design Guide is predicated on the belief that the more compatible a design is with its landscape setting, the less significant or visually intrusive it will be.

The Design Guide considers the visual effect of the mobile phone base station and does not take account of other equally important aspects such as OH&S and EME issues. In this regard, the Design Guide is an additional assessment tool for the site acquisition team rather than superseding other site requirements.

The Design Guide responds to a range of landscape characteristics, creating design recommendations that are contextually specific and sensitive to the visual environment. The Design Guide also determines the degree of visual change that is anticipated by assessing the design's compatibility against the visual sensitivity of the site - the greater the sensitivity of the site, the greater the need to achieve compatibility. Built into the Design Guide is the recognition that not all landscape contexts require the same level of design response.

The Design Guide is comprised of three interactive Excel spreadsheets which address:

- Landscape Context and Design Response;
- Visual Sensitivity; and
- Visual Change.

Each of these spreadsheets is discussed separately below.

2.1 Spreadsheet One-Landscape Context and Design

Spreadsheet One considers landscape context and design and comprises the following stages:

1. A structured process to document the landscape context that the proposed mobile phone base station is to be located within including:
    - Land use;
    - Topography;
    - Built form;

- Sky lining;
- Containment;
- Vegetation;
- Existing telecommunications equipment; and
- Colour.

More detailed explanations as to what these factors are and how to assess them is provided within Spreadsheet One and the Glossary of Terms in section 4 of this User Manual.

2. The generation of a series of recommendations or "design brief" based on the assessment of the landscape context, which suggests how to design a mobile phone base station that will fit best within the existing documented landscape context and therefore deliver better visual outcomes. Design recommendations are provided for the four main structural components of mobile phone base stations including poles and towers, antennas mounts, equipment cabins and antennas and cables. These recommendations then provide a design brief for the structural engineering development of the mobile phone base station design.
3. Assessment of the compatibility of the actual design produced (contract documentation or as constructed) in relation to the landscape context i.e. the number of recommendations that have been incorporated into the final design that were generated by the Design Guide.

The recommendations or design brief that is produced as a result of the landscape assessment is the ultimate design and will result in the best possible visual outcome for that site. It is acknowledged however, that there will be situations were specific design recommendations made by the Design Guide cannot be achieved due to issues such as access, radio frequency objectives engineering or cost constraints.

This does not necessarily mean that the site will result in a poor visual outcome. Built into the Design Guide is the recognition that not all landscape contexts require the same level of design response.

2.2 Spreadsheet Two-Visual Sensitivity

To assist Carriers and their consultants to determine what level of compatibility is required in what location Spreadsheet Two provides a process which documents and assesses the visual sensitivity of the identified site.

Factors which are considered in determining visual sensitivity include:

- Visibility
- Prominence (eyeline)
- Access (duration)
- Community (visitation)
- Existing infrastructure
- Cultural representation

More detailed explanations as to what these factors are and how to assess them is provided within spreadsheet two.

For each of these factors, four choices are provided and are assigned different numeric values. Once a number is inputted for each of these factors, a total is recorded and the visual sensitivity of the site has been quantified.

Using this process, the site acquisition team can develop an understanding of where the proposed base station will be seen, by whom and how many people are likely to be effected. The aim of this process is to assist in identifying site locations which will be visually sensitive due to factors such as being located in an open, flat area that is visited or viewed often such as a main street. By understanding the degree of visual sensitivity of a proposed site location, an informed design response can be prepared.

2.3 Spreadsheet Three-Visual Change

Spreadsheet Three provides an indication of the degree of visual change that is anticipated as a result of constructing the proposed mobile phone base station design in the identified location.

Using the information determined by Spreadsheet One and Two i.e. design compatibility and visual sensitivity, Spreadsheet Three qualifies the degree of visual change that is likely to occur.

This process can assist with risk management and highlights those sites which are likely to be visually sensitive and therefore warrant more emphasis being placed on design compatibility.

3.0 GETTING STARTED-IMPLEMENTING THE DESIGN GUIDE

3.1 When should the Design Guide be Used?

The Design Guide can be used at any stage of the site acquisition process, but it is anticipated that it will be most useful, cost effective and time efficient **once a preferred site candidate is confirmed** having regard to all the other factors that influence the site selection process

The Design Guide can be integrated into current site acquisition processes and does not replace any of the current practices undertaken by Carriers. **It does not replace existing information gathering, consultation and assessment processes, but rather provides an additional layer of information that can be fed into the site acquisition process** and assist in the design of mobile phone base station sites for construction. In addition, the Design Guide provides the opportunity to review mobile phone base stations once constructed to determine their "visibility" and enables Carriers to review and evaluate as constructed designs.

It is recognised that there are a range of other objectives that influence site selection including the availability of land, requirements of the landowner, occupational health and safety, cost, access for maintenance purposes, construction issues and radio frequency requirements such as coverage objectives, capacity, network design constraints, line of sight and height of surrounding buildings, trees and other structures.

The Design Guide can be used to meet some of these objectives. For example, negotiations with a landowner who takes a particular interest in the compatibility of the design with the property can be supported through the use of the Design Guide during the negotiation process.

3.2 Who should be responsible for implementing the Design Guide?

One member of the site acquisition team can be responsible for collecting and inputting the information into the Design Guide and it is anticipated that either the planning or property team members will undertake this role. More than one member can implement the Design Guide for the same site if preferred and results can be compared. Base station designs can also be reviewed retrospectively (ie once constructed).

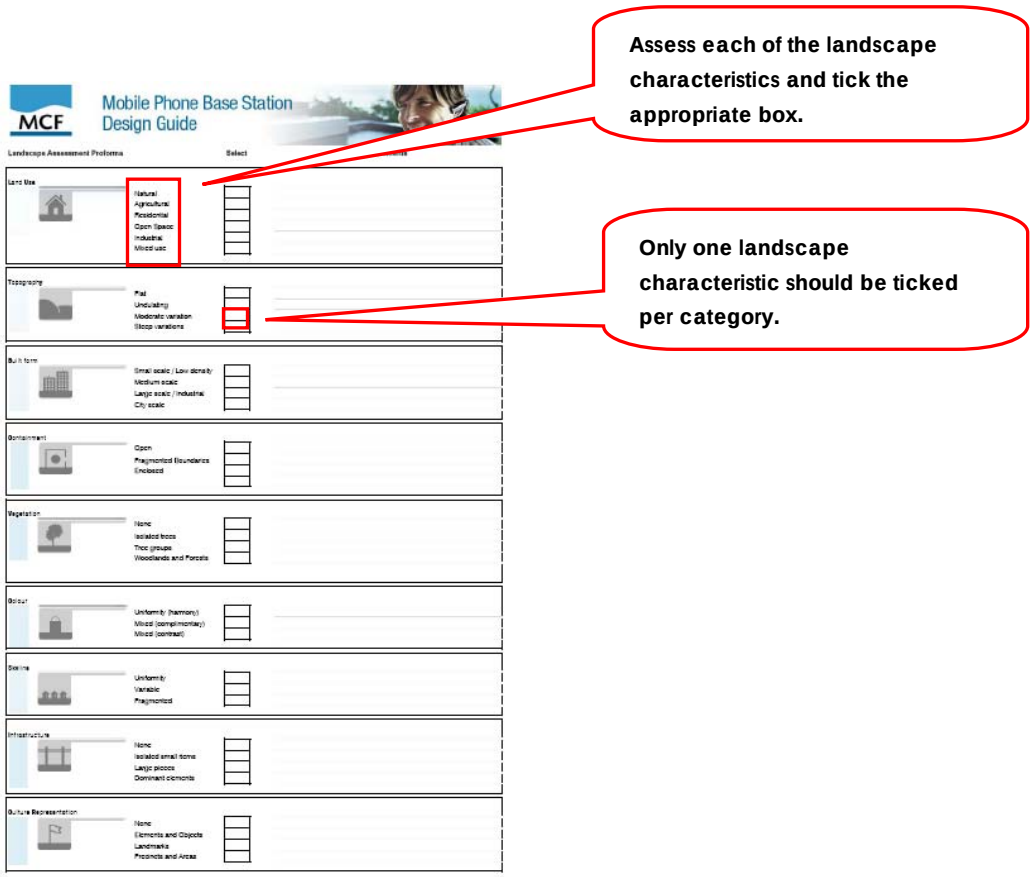
3.3 What do we do?

This section of the User Manual provides step by step instructions regarding the implementation of the Design Guide. Each of the three spreadsheets that comprise the Design Guide is described in detail below.

3.3.1 Landscape Context and Design-Spreadsheet One

Step 1-Take a hard copy of the landscape assessment pro forma on site.

Step 2-When out on site make an assessment of the key landscape characteristics identified on the pro forma and tick the appropriate box. The assessment should be carried out within a 150-200m radius of the proposed location and should consider the dominant elements (key landscape characteristics). Only one landscape characteristic should be identified per category.


Assess each of the landscape characteristics and tick the appropriate box.
Only one landscape characteristic should be ticked per category.
MCF
Mobile Phone Base Station
Design Guide

The landscape characteristics identified in the Design Guide have been developed based on a scale of variations. For example, the topography category provides four selections ranging from flat through to steep variations. The description that most closely represents the landscape context of the site being assessed or the most dominant characteristic should be chosen. A Glossary of Terms is provided in section 4 of this User Manual to assist with the identification of landscape characteristics for each category.

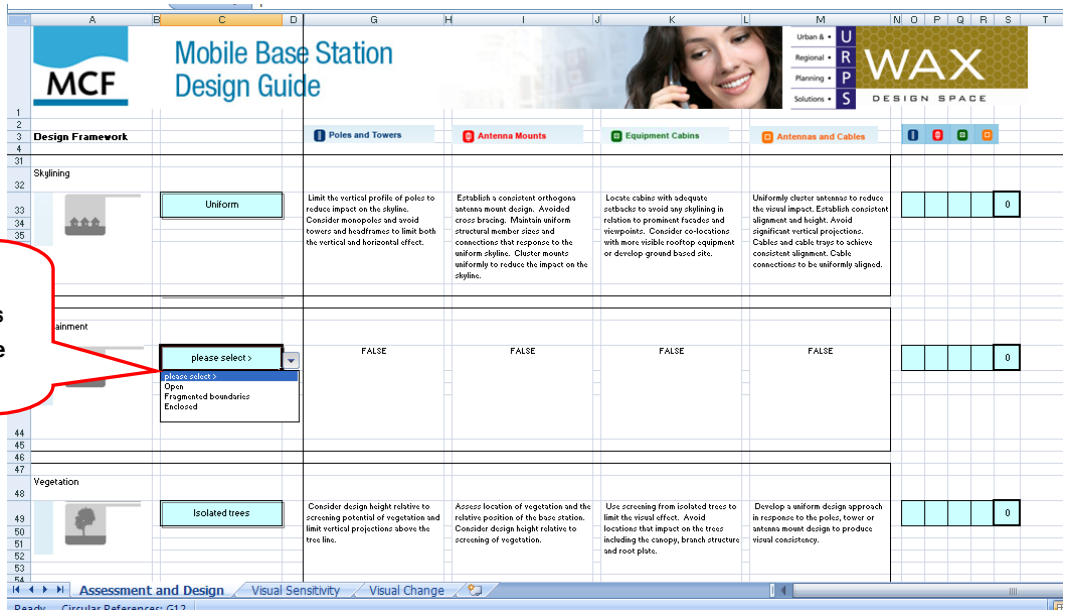
The identification of the landscape characteristics develops a baseline measurement of the existing landscape context. Aspects critical to visual effect are documented and assessed and include:

- Land use;
- Topography
- Built form;
- Sky lining;
- Containment;
- Vegetation;
- Existing telecommunications equipment;
- Colour

Once the pro forma has been completed on site, the remaining work for Spreadsheet One can be undertaken back in the office.

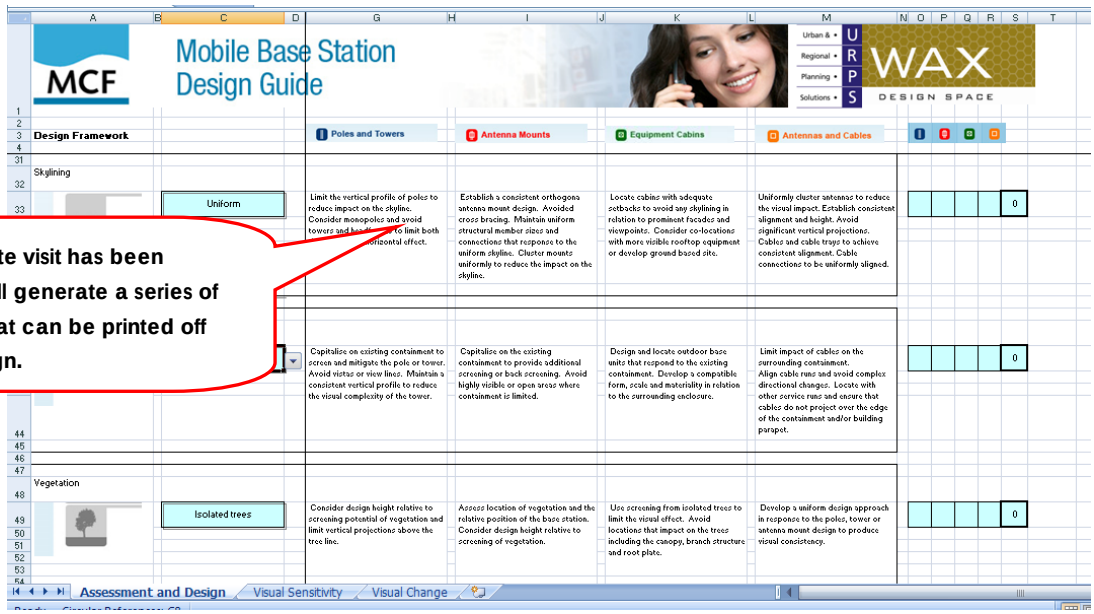
Note that the visibility assessment needs to be undertaken on site as well and requires the completion of a pro forma (refer to section 3.3.2).

Step 3-Once the landscape assessment pro forma has been completed on-site it should be inputted into Spreadsheet One once back in the office. Alternatively, depending on available technology, the information can be inputted directly into the Design Guide on-site.


Mobile Base Station Design Guide
MCF
WAX DESIGN SPACE
Design Framework
Poles and Towers
Antenna Mounts
Equipment Cabins
Antennas and Cables
Skylining
Uniform
Limit the vertical profile of poles to reduce impact on the skyline. Consider monopoles and avoid towers and headframes to limit both the vertical and horizontal effect.
Establish a consistent orthogonal antenna mount design. Avoided cross bracing. Maintain uniform structural member sizes and connections that response to the uniform skyline. Cluster mounts uniformly to reduce the impact on the skyline.
Locate cabins with adequate setbacks to avoid any skylining in relation to prominent facades and viewpoints. Consider co-locations with more visible rooftop equipment or develop ground based site.
Uniformly cluster antennas to reduce the visual impact. Establish consistent alignment and height. Avoid significant vertical projections. Cables and cable trays to achieve consistent alignment. Cable connections to be uniformly aligned.
please select >
Open
Fragmented boundaries
Enclosed
FALSE
Vegetation
Isolated trees
Consider design height relative to screening potential of vegetation and limit vertical projections above the tree line.
Assess location of vegetation and the relative position of the base station. Consider design height relative to screening of vegetation.
Use screening from isolated trees to limit the visual effect. Avoid locations that impact on the trees including the canopy, branch structure and root plate.
Develop a uniform design approach in response to the poles, tower or antenna mount design to produce visual consistency.
Assessment and Design
Visual Sensitivity
Visual Change

Once back in the office input the landscape characteristics into the spreadsheet using the drop down boxes.

Step 4-Once the information has been transferred from the pro forma to the spreadsheet the Design Guide will generate a series of design recommendations or the "design brief" for the proposed site. These design recommendations should be printed off and provided to the site designer/ acquisition team/engineer as a basis for designing the proposed mobile phone base station.


Mobile Base Station Design Guide
MCF
WAX DESIGN SPACE
Design Framework
Poles and Towers
Antenna Mounts
Equipment Cabins
Antennas and Cables
Skylining
Uniform
Limit the vertical profile of poles to reduce impact on the skyline. Consider monopoles and avoid towers and headframes to limit both the vertical and horizontal effect.
Establish a consistent orthogonal antenna mount design. Avoided cross bracing. Maintain uniform structural member sizes and connections that response to the uniform skyline. Cluster mounts uniformly to reduce the impact on the skyline.
Locate cabins with adequate setbacks to avoid any skylining in relation to prominent facades and viewpoints. Consider co-locations with more visible rooftop equipment or develop ground based site.
Uniformly cluster antennas to reduce the visual impact. Establish consistent alignment and height. Avoid significant vertical projections. Cables and cable trays to achieve consistent alignment. Cable connections to be uniformly aligned.
Capitalise on existing containment to screen and mitigate the pole or tower. Avoid visitas or view lines. Maintain a consistent vertical profile to reduce the visual complexity of the tower.
Capitalise on the existing containment to provide additional screening or back screening. Avoid highly visible or open areas where containment is limited.
Design and locate outdoor base units that respond to the existing containment. Develop a compatible form, scale and materiality in relation to the surrounding enclosure.
Limit impact of cables on the surrounding containment. Align cable runs and avoid complex directional changes. Locate with other service runs and ensure that cables do not project over the edge of the containment and/or building parapet.
Vegetation
Isolated trees
Consider design height relative to screening potential of vegetation and limit vertical projections above the tree line.
Assess location of vegetation and the relative position of the base station. Consider design height relative to screening of vegetation.
Use screening from isolated trees to limit the visual effect. Avoid locations that impact on the trees including the canopy, branch structure and root plate.
Develop a uniform design approach in response to the poles, tower or antenna mount design to produce visual consistency.
Assessment and Design
Visual Sensitivity
Visual Change

Once information from the site visit has been inputted, the spreadsheet will generate a series of design recommendations that can be printed off and used as a basis for design.

Step 5-A design for the site can then be prepared using the Design Guide's recommendations by the relevant member/s of the site acquisition team. These recommendations may or may not be adhered to depending on the individual circumstances of the site and other issues that need to be addressed such as cost, radio frequency objectives, access, engineering issues site constraints and landowner preferences.

It is up to the site acquisition team or Carrier to determine the extent to which the recommendations of the design brief are addressed and incorporated into the final design.

Step 6-Once the design has been prepared it should be assessed in terms of how well it addresses the design recommendations generated by the Design Guide and therefore its compatibility with the landscape context.

This is undertaken by inputting a number 0, 1 or 2 into the Design Response column of Spreadsheet One. Entering zero means that the design recommendation has not been achieved at all, entering one means that it has been partially achieved and entering two means that it has been achieved.

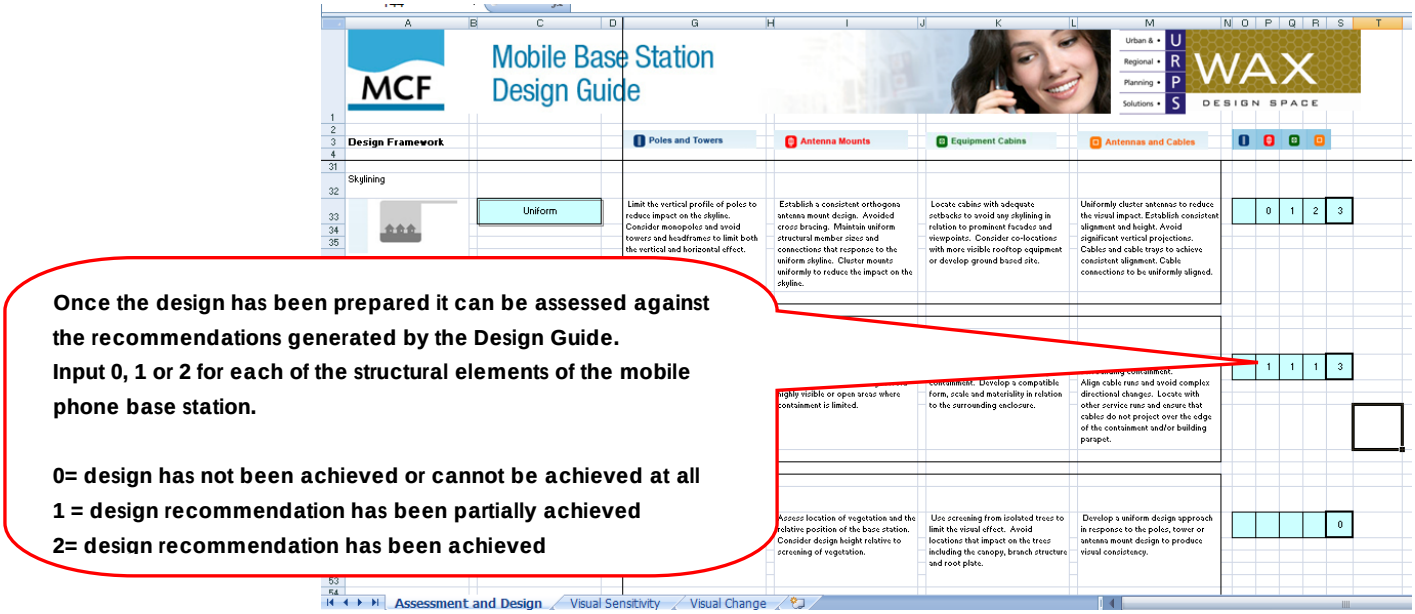
0 Design has not been achieved or cannot be achieved

1 Design recommendation has been partially achieved

2 Design recommendation has been achieved

Each of the main structural elements of a mobile phone base station can be assessed and include:

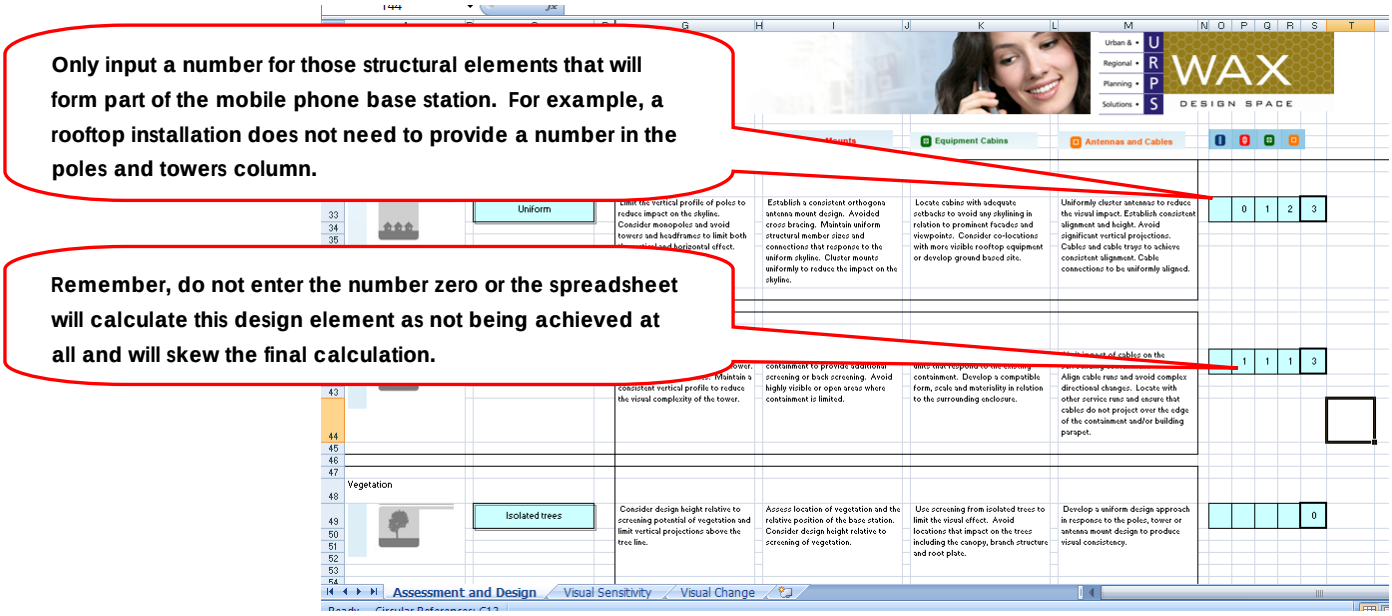
- Poles and towers
- Antenna mounts
- Equipment cabins
- Antennas and cables



Once the design has been prepared it can be assessed against the recommendations generated by the Design Guide.
Input 0, 1 or 2 for each of the structural elements of the mobile phone base station.

0= design has not been achieved or cannot be achieved at all
1 = design recommendation has been partially achieved
2= design recommendation has been achieved

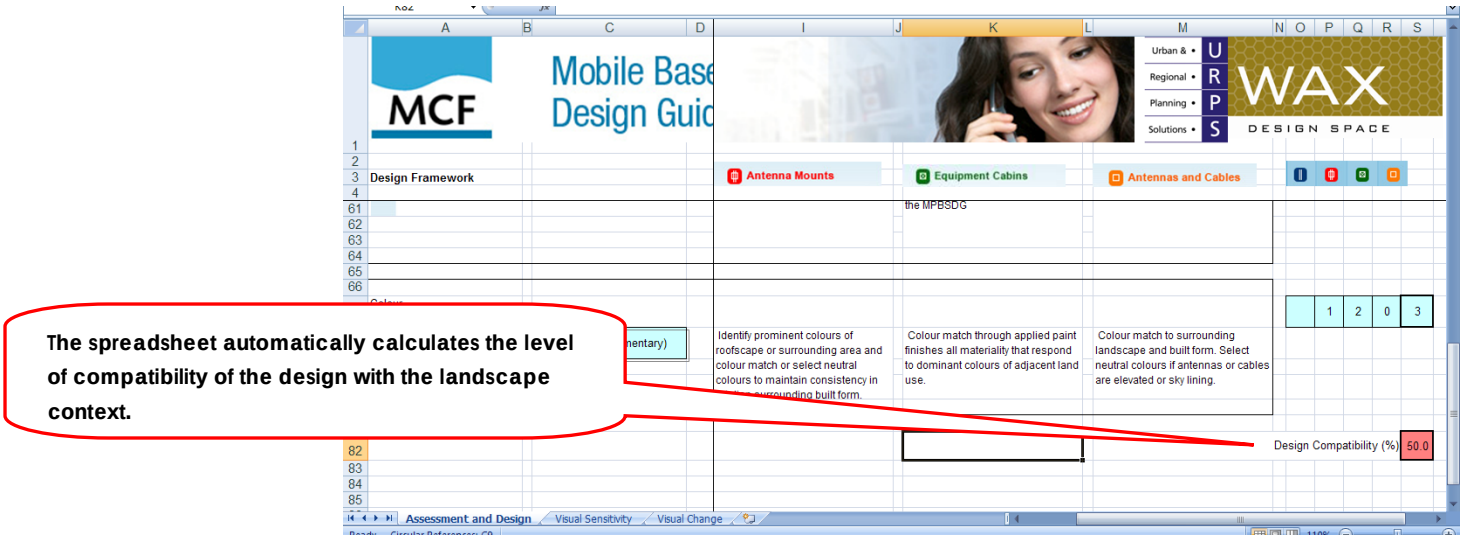
Only the cells in Spreadsheet One for those structural elements which will form part of the mobile phone base station site should be completed. For example, where a site is a rooftop installation, there is no need to assess the proposed design in terms of achieving the design recommendations listed in the "poles and towers" column of the spreadsheet. The corresponding cell in the assessment column should therefore be left blank. **Do not enter zero** as the spreadsheet will calculate this design element as not being achieved at all and will skew the final calculation.



Only input a number for those structural elements that will form part of the mobile phone base station. For example, a rooftop installation does not need to provide a number in the poles and towers column.

Remember, do not enter the number zero or the spreadsheet will calculate this design element as not being achieved at all and will skew the final calculation.

The spreadsheet automatically calculates the level of compatibility of the design with the landscape context and uses this number in calculations undertaken in Spreadsheets Two and Three.


The spreadsheet automatically calculates the level of compatibility of the design with the landscape context.
MCF
Mobile Base
Design Guic
WAX
DESIGN SPACE
Design Framework
Antenna Mounts
Equipment Cabins
Antennas and Cables
the MPBSDG
Identify prominent colours of roofscape or surrounding area and colour match or select neutral colours to maintain consistency in
Colour match through applied paint finishes all materiality that respond to dominant colours of adjacent land use.
Colour match to surrounding landscape and built form. Select neutral colours if antennas or cables are elevated or sky lining.
1 2 0 3
Design Compatibility (%) 50.0
Assessment and Design
Visual Sensitivity
Visual Change

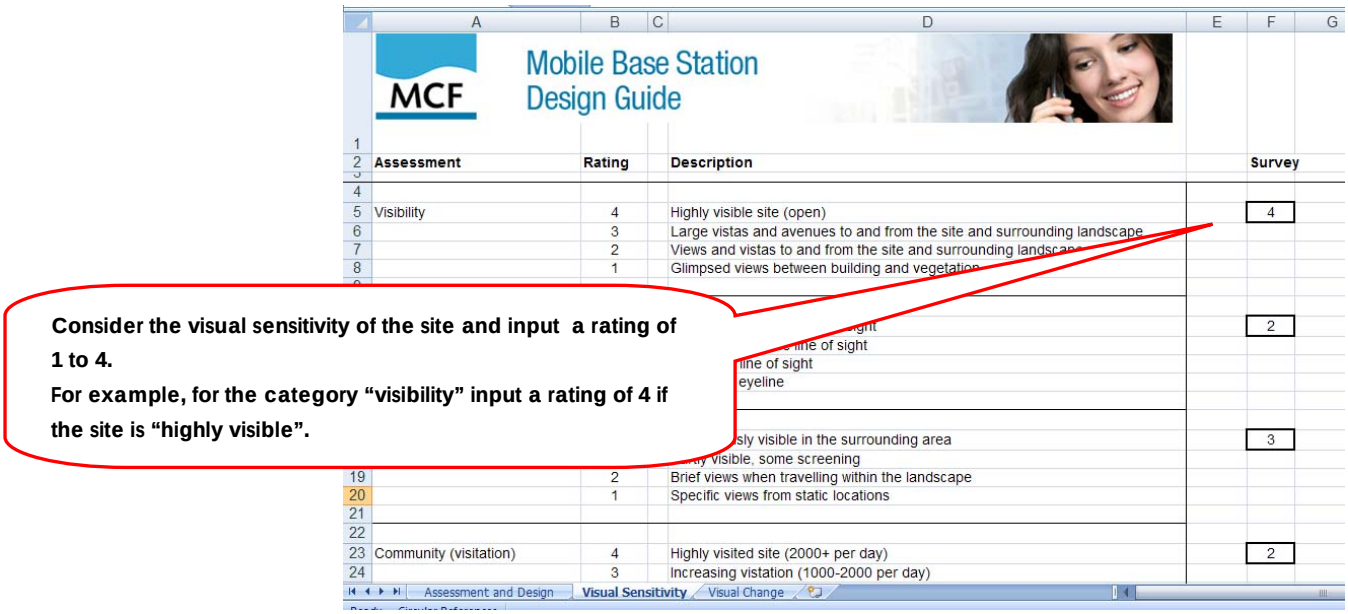
3.3.2 Visual Sensitivity- Spreadsheet Two

Step 1-Take a hard copy of the visibility assessment pro forma on site.

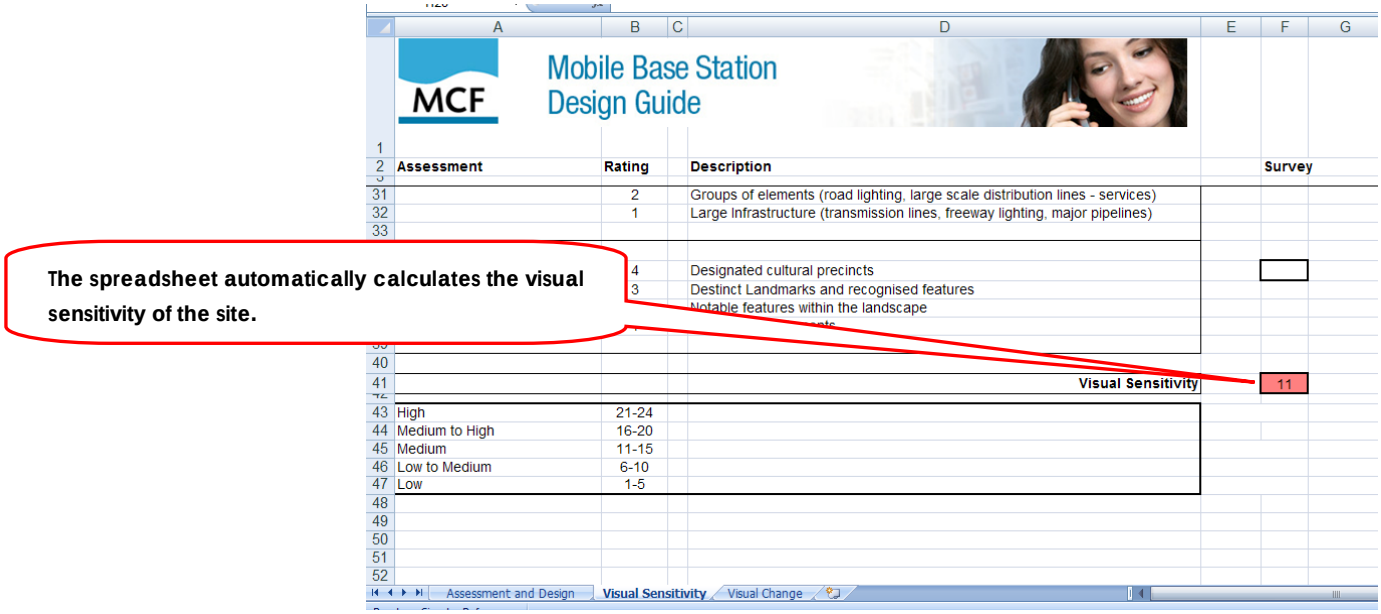
Step 2-When on site make an assessment of each of the categories and relevant descriptions identified on the pro forma using a rating of 1 to 4 which are assigned to each of the descriptions for each category.

Similar to the Landscape Context assessment, the visibility should be assessed within 150-200m of the proposed site. Only one description should be chosen to describe each category. The description that most closely represents the dominant visual context of the site being assessed should be chosen. For example, for the category "visibility", a rating of 4 should be chosen if the site is "highly visible".

Some of this information may need to be gathered back in the office such as historic or cultural planning designation or overlay.



Step 3-Transfer the numbers from the visibility assessment pro forma to Spreadsheet Two of the Design Guide. The spreadsheet will automatically generate a value which is identified as the visual sensitivity of the proposed site.



The spreadsheet identifies a scale ranging from low to high which can be used to describe the visual sensitivity of the site. This value is used automatically in further calculations undertaken in Spreadsheet Three.

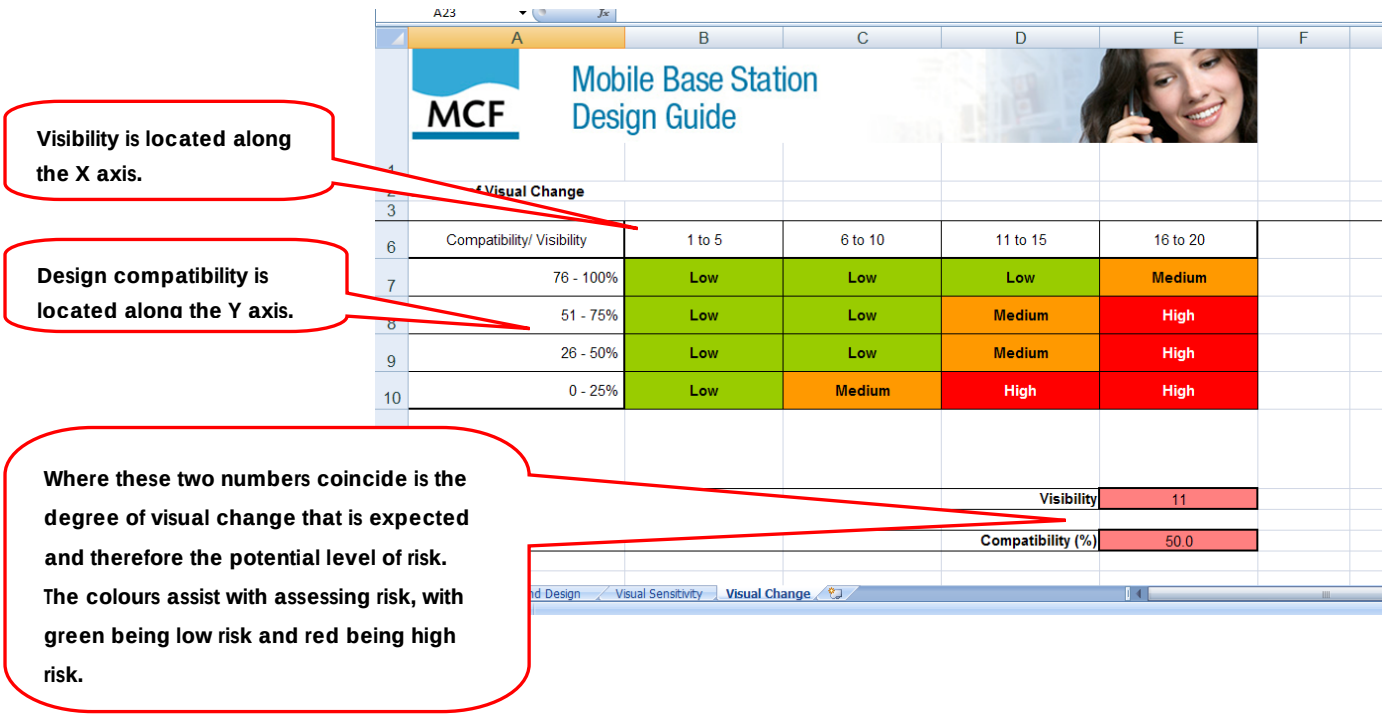
3.3.3 Degree of Visual Change-Spreadsheet Three

Spreadsheet Three assesses the compatibility of the proposed engineered design relative to its visibility and the anticipated visual effect of the proposed mobile phone base station if it were to be built. This process considers whether the proposed design is in keeping with the recommendations generated by the Design Guide based on the landscape assessment, while also having reference to the visual sensitivity of the site. **The greater the sensitivity of the site, the greater the need to achieve compatibility.**

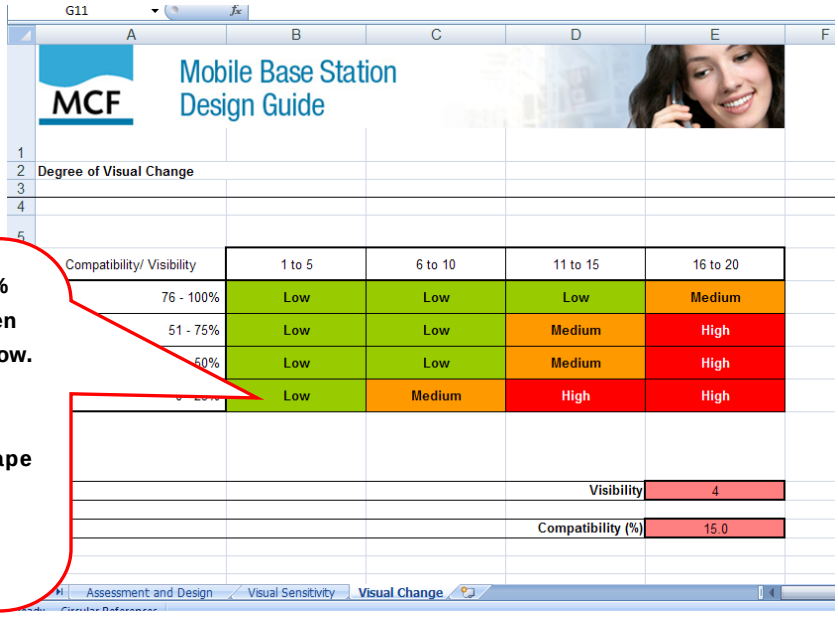
The design compatibility value from Spreadsheet One (i.e. the level of achievement of the design recommendations generated as a result of the landscape assessment) and the visual sensitivity value from Spreadsheet Two are automatically transferred to Spreadsheet Three.

To determine the degree of visual change as a result of constructing the proposed design for the mobile phone base station in the identified location use the table provided in Spreadsheet Three to identify the relationship between design compatibility and site visibility.

Design compatibility is located along the y axis and site visibility along the x axis. Where these two values coincide is the degree of visual change that is expected and therefore the potential level of risk. The table uses colours to assist with the assessment, with green being low risk and red being high risk.


Visibility is located along the X axis.
Design compatibility is located along the Y axis.
Where these two numbers coincide is the degree of visual change that is expected and therefore the potential level of risk. The colours assist with assessing risk, with green being low risk and red being high risk.
MCF
Mobile Base Station Design Guide
Visual Change
Compatibility/ Visibility
1 to 5
6 to 10
11 to 15
16 to 20
76 - 100%
51 - 75%
26 - 50%
0 - 25%
Low
Medium
High
Visibility
11
Compatibility (%)
50.0
Visual Sensitivity
Visual Change

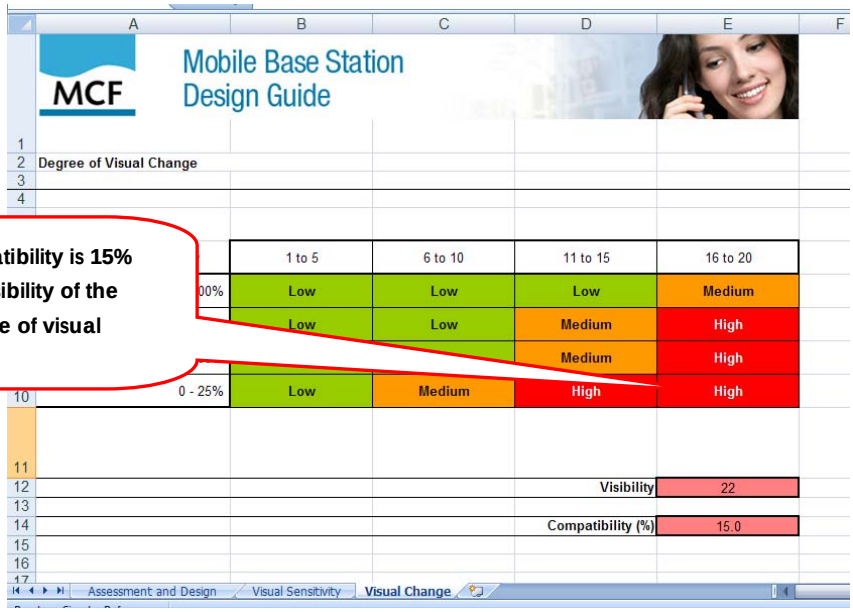
For example, if the design compatibility is 15% and the visual sensitivity or visibility is 4, then the degree of visual change is low. In this scenario, it may not be necessary to make design changes as the existing landscape context does not require a high degree of design and visual compatibility.



If the design compatibility is 15% and the visual sensitivity is 4, then the degree of visual change is low. In this scenario, it may not be necessary to make design changes as the existing landscape context does not require a high degree of design and visual compatibility response.

However, if the design compatibility is 15% and the visual sensitivity or visibility of the proposed site is 22, the degree of visual change is high. In this scenario, it would be recommended that the design response be amended to more accurately reflect the recommendations generated by the Design Guide in Spreadsheet One.

However, if the design compatibility is 15% and the visual sensitivity or visibility of the proposed site is 22, the degree of visual change is high.



The benefit of Spreadsheet Three is that it provides a risk management framework which can be used to assess where resources including financial and personnel should be focussed for different sites based on comprehensive analysis and assessment.

4.0 GLOSSARY OF TERMS

This glossary of terms can be used to assist with undertaking the landscape assessment related to spreadsheet one and identifying the dominant landscape element for each category.

LAND USE

Natural: Landscapes dominated by large areas of native vegetation (tree, shrubs and grasses), unmodified landforms (hills, creeks and cliffs), with an absence of human impact or development.

Agricultural: Modified landscape defined by fields and paddocks, isolated trees and development associated with agricultural practices (sheds, farmhouses, fencing, pipelines, powerlines and roads).

Residential: Developed areas of land comprised of single and double storey dwellings, road boundary treatments (fences, hedges and walls) and formal landscape elements (tree avenues and ornamental gardens).

Open space: Open areas of land associated with development, providing opportunities for unstructured and structured recreation and comprising trees, planting areas, playgrounds and sportsgrounds.

Industrial: Land dominated by warehouses, sheds and other infrastructure associated with manufacturing processes.

Mixed use: Land use associated with urban areas, consisting of a mixture of development forms such as commercial, residential and industrial that vary in size from larger double storey buildings to city scale built form.

TOPOGRAPHY

Flat: Landscape areas with no apparent change in level.

Undulating: Areas with small variations in land form, including mounds, creek lines, embankments and shallow slopes.

Moderate variation: Pronounced level changes and defined topographic features comprising of hills, valleys, slopes and escarpments.

Steep variations: Major topographic variations with significant level changes creating a landscape punctuated with large hills, steep slopes, escarpments and incised watercourses.

BUILT FORM

Small scale, low density: Single or isolated development within large blocks or areas of land

Medium scale: Single and double storey development within smaller defined landscape areas or blocks

Large scale/industry: Large building mass relative to surrounding land, creating a large building footprint.

City scale: Increased height and frequency of built form with an absence of open space and dominance of development.

SKYLINING

Uniform: The interface between sky and the adjacent roof-lines, tree tops of ridgelines ('the line between the sky and the ground') exhibits little variation with few changes in angle, frequency, rhythm or scale.

Variable: The impact of different building forms, tree heights and other elements combine to create a dynamic skyline with continually changing angles, forms and scales.

CONTAINMENT

Open:	Locations or sites that have no buildings or infrastructure surrounding the locality creating a panoramic visual character (e.g. parks or fields).
Fragmented boundaries:	The presence of some buildings provide screening of, and glimpsed views to, surrounding localities, creating a varied visual character of filtered views (e.g. residential street, school or shopping centre).
Enclosed:	The locality or site is predominantly enclosed by the surrounding built form, which defines the containment of the site (e.g. city streets, urban square or plaza)

VEGETATION

None:	There is a complete absence of vegetation, either trees or shrubs.
Isolated:	Constituting individual and small copses (groups) of trees such as field trees or garden trees.
Tree groups:	A collection of trees within one area, consistent with street trees, avenues, windbreak tree planting and small woodlands (a 5-10 tree group).
Woodlands and forests:	Large areas of exotic, semi-natural and natural vegetation as such forestry plantations and native bush land.

EXISTING TELECOMMUNICATIONS EQUIPMENT

None:	No pieces of telecommunication equipment exist in relation to the site or locality.
Isolated:	Occasional pieces of equipment are evident within the area, seen as isolated objects.
Groups of elements:	A collection of telecommunication equipment that form notable elements in the landscape.

COLOUR

Uniformity (harmony):	The colour and colouration of the locality is considered uniform with a single colour, hue or range of colours (e.g. browns) dominating the area.
Mixed (complementary):	A variety of colours exist within the locality that are similar in relation to tone (e.g. light colours) or are complementary (e.g. creams and browns).
Mixed:	The colours of the area are different and/or discordant creating a variable colouration of the *area (e.g. pink, blue and green)*